



IML News

IML Coordinators:

Anja Butter (TH), Stefano Carrazza (TH), Fabio Catalano (ALICE), Julián García Pardiñas (LHCb),
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Upcoming meetings



IML website: <https://iml.web.cern.ch/homepage>

General mailing list ([self-subscription](#)): lhc-machinelearning-wg@NOSPAMcern.ch

➔ **Next IML meeting on the 27th of July: unfolding.**

The agenda is evolving here: <https://indico.cern.ch/event/1271641/>

Please contact us (iml.coordinators@cern.ch) If you would like to present!

➔ **There will be no monthly meeting in August.**

We will resume in September.

6th IML Workshop

As previously announced, Workshop dates changed to:
29th January - 2nd February 2024

[New!] Evolving website: <https://indico.cern.ch/event/1297159/>

We will follow up with more information through the IML mailing list.

The screenshot shows the Indico event page for the 6th Inter-experiment Machine Learning Workshop. The header is blue with the event title in white. Below the header, the event dates (29 January 2024 to 2 February 2024) and location (CERN, Europe/Zurich timezone) are listed on the left, and a search bar is on the right. A sidebar on the left contains navigation links: Overview (selected), Scientific Programme, Call for Abstracts, Timetable, and Code of conduct. Below the sidebar, the 'Contact' section is highlighted in blue, showing the email address iml.coordinators@cern.ch. The main content area contains three paragraphs: the first states the workshop dates; the second notes the hybrid format and the possibility of moving to online-only; the third mentions accommodation options at CERN Hostel or nearby hotels; and the fourth advises registration to the lhc-machinelearning-wg@cern.ch CERN egroup.

Today's agenda

IML Machine Learning Working Group

Tuesday 11 Jul 2023, 15:00 → 16:20 Europe/Zurich
6/2-024 - BE Auditorium Meyrin (CERN)

Description Open topic meeting

15:00 → 15:05 **News** ⌚ 5m

Speakers: Anja Butter (Centre National de la Recherche Scientifique (FR)), Fabio Catalano (CERN), Julian Garcia Pardiñas (CERN), Lorenzo Moneta (CERN), Michael Kagan (SLAC National Accelerator Laboratory (US)), Dr Pietro Vischia (Universidad de Oviedo and Instituto de Ciencias y Tecnologías Espaciales de Asturias (ICTEA)), Stefano Carrazza (CERN)

15:05 → 15:25 **A Deep Learning Approach to Proton Background Rejection for Positron Analysis with the AMS Electromagnetic Calorimeter** ⌚ 20m

The Alpha Magnetic Spectrometer (AMS) is a high-precision particle detector onboard the International Space Station containing six different subdetectors. The Transition Radiation Detector and Electromagnetic Calorimeter (ECAL) are used to separate electrons/positrons from the abundant cosmic-ray proton background.

The positron flux measured in space by AMS falls with a power law which unexpectedly softens above 25 GeV and then hardens above 280 GeV. Several theoretical models try to explain these phenomena, and a purer measurement of positrons at higher energies is needed to help test them. The currently used methods to reject the proton background at high energies involve extrapolating shower features from the ECAL to use as inputs for boosted decision tree and likelihood classifiers.

We present a new approach for particle identification with the AMS ECAL using deep learning (DL). By taking the energy deposition within all the ECAL cells as an input and treating them as pixels in an image-like format, we train an MLP, a CNN, and multiple ResNets and Convolutional vision Transformers (CvTs) as shower classifiers. Proton rejection performance is evaluated using Monte Carlo (MC) events and AMS data separately. For MC, using events with a reconstructed energy between 0.2 – 2 TeV, at 90% electron accuracy, the proton rejection power of our CvT model is more than 5 times that of both the other DL models and the AMS models. Similarly, for AMS data with a reconstructed energy between 50 – 70 GeV, the proton rejection power of our CvT model is more than 2.5 times that of the AMS models.

Speaker: Raheem Hashmani (Middle East Technical University (TR))

15:25 → 15:30 **Questions** ⌚ 5m

15:30 → 15:50 **Particle-flow End-to-end reconstruction for Highly Granular Calorimeters** ⌚ 20m

Speakers: Mr Philipp Zehetner (Ludwig Maximilians Universität (DE)), Shah Rukh Qasim (CERN)

15:50 → 15:55 **Questions** ⌚ 5m

15:55 → 16:15 **Jet Diffusion versus JetGPT -- Modern Networks for the LHC** ⌚ 20m

We introduce two diffusion models and an autoregressive transformer for LHC physics simulations. Bayesian versions allow us to control the networks and capture training uncertainties. After illustrating their different density estimation methods for simple toy models, we discuss their advantages for Z plus jets event generation. While diffusion networks excel through their precision, the transformer scales best with the phase space dimensionality. Given the different training and evaluation speed, we expect LHC physics to benefit from dedicated use cases for normalizing flows, diffusion models, and autoregressive transformers.

Speaker: Nathan Huetsch (University of Heidelberg)

16:15 → 16:20 **Questions** ⌚ 5m